University of Nevada, Reno

Down-Hole Tritium Analysis System for Deep Monitoring Wells

Technology Need:

Over 925 underground nuclear tests were conducted between 1961 and 1992 at the Nevada Test Site (NTS). This enabled radioactive products including tritium to enter the ground water. A monitor well system was established at and around the NTS and public concern is such that the State of Nevada may require sampling of these wells for 100 years or longer. The DOE has estimated that sampling of the monitor wells for 100 years by current practices would cost over $150 million in present day dollars. Consequently, there is a large financial incentive to develop down-hole monitors to replace the current pump and sample technology.

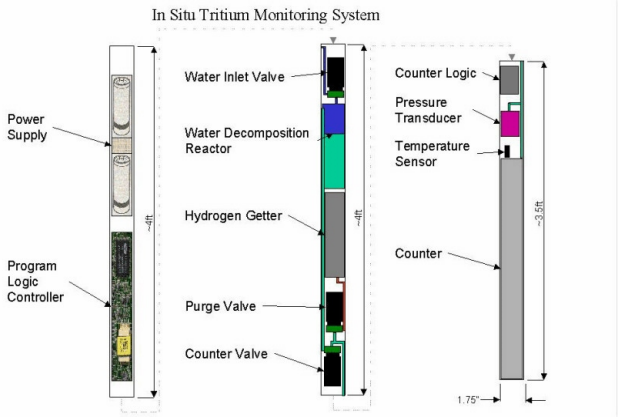
Tritium is the principal contaminant of concern. Currently, tritium concentrations are determined in the laboratory which requires a crew of people to pump at least three well volumes of water to the surface before pumping additional water for a sample.

Technology Description:

The University of Nevada, Reno proposes a down-hole tritium analysis system that meets the DOE's needs for real time data, risk minimization and the requirement imposed by monitor wells of occupying less than 2 inches diameter. A tritium detector/monitor concept, based on gasification of a water sample and proportional detector of tritium in the gas, was developed by the University of Nevada, Reno under a DOE-NERP project that was funded during fiscal years 1999-2001. A prototype proportional detector was constructed by Ludlum Measurements, Inc. and the unit can meet the required 1000 pCi/L detection limit with a confidence level >92%.

Gas-proportional detectors offer superior sensitivity to down-hole scintillation systems and are better suited to measuring the low energy β radiation from tritium. Proportional detectors are gas filled tubes containing several very fine wire electrodes. When a tritium atom decays by emitting a β particle, the particle travels until it strikes a gas molecule and is absorbed. Absorption of additional energy ionizes molecules of gas into electron-ion pairs and the resulting charge multiplication is proportional to the number of β particles emitted. The proportional detector can discriminate the β decay from tritium even in the presence of gamma radiation from radioactive isotopes naturally present in the rock surrounding the well casing.

The gas-proportional detector will receive a tritiated hydrogen gas stream derived from the water sample by reaction with an active metal. Sodium was chosen as the metal because it is safe, reacts completely and is rapid. Electrolysis, an alternative for decomposing water, is much slower.



The design calls for four major components; the detector tube, the sodium-water reaction chamber, the surface control and data processing system, and the connection system linking the down-hole and surface equipment. The detector operation will be controlled from the surface by the operation of electrical or

pneumatic valves located within the detector unit. The tritium monitor system will be equipped with a small circulating pump that draws water from the well through a small diameter pipe

Benefits:

▸Technology replaces the current tritium analysis method, which requires sending a crew of people on site to pump a well sample, lowering risk to site personnel.

▸Downhole tritium monitor system will provide substantial cost savings to the DOE and eliminate disposal of large quantities of contaminated water.

▸It will give tritium analyses at precise depths in the well rather than the current average concentration over complete aquifer thickness.

▸Data will be available remotely, in real time.

▸Use of the proposed technology will have minimal impact on the environment.

Status and Accomplishments:

This project was initiated on September 30, 2001. A method for separating tritiated hydrogen gas has been successfully tested. A polymeric hydrogen getter was applied to a 50 % hydrogen - 50 % propane gas mixture. Over 95% of the hydrogen was removed in one hour of contact with the getter. This result can be extrapolated to tritiated hydrogen gas as the tritiated and H2 molecules exhibit the same behavior. The Conceptual Design Report was completed and approved by DOE. The fabrication of the prototype sensor has been initiated. Once fabrication is completed, bench scale testing will commence.

Contacts:

Thomas G. Carnahan
University of Nevada, Reno
Phone: 775-327-5130
E-mail: tomc@unr.edu

Ron Staubly
National Energy Technology Laboratory
Phone: (304) 285-4991
E-mail: ron.staubly@netl.doe.gov

Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 3171
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov